Stable isotopes and trophic position of commercially exploited Mediterranean littoral fishes

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Stable carbon and nitrogen isotopes signatures have been determined for littoral fishes from the Balearic Islands and Columbretes Islands MPA (NW Mediterranean) for trophic assessment. With the aim of investigating the aspects of fish feeding and to compare trophic levels between locations subject to different protection status, four species of fishes associated to by-catch in the Spanish lobster fishery were analyzed (*Phycis phycis*, *Raja polystigma*, *Scorpaena scrofa* and *Zeus faber*). The sampling was performed during summer 2009, in two locations in Columbretes Island MPA, one where fishing is forbidden and another where it is permitted; and two locations in the Balearic Islands, Cala Ratjada (Mallorca) and Ciutadella (Menorca). Variation in the isotopic composition was examined at multiple levels: individual organism, individual populations and at area effects (different locations) with a distance based permutational analysis of variance (PERMANOVA). When analysing spatial differences, all fish species exhibited significant differences in both $\delta^{13}C$ and $\delta^{15}N$ for the pairwise test Columbretes-Cala Ratjada, and Columbretes-Ciutadella. Fish specimens from Columbretes showed an enrichment in $\delta^{13}C$ ranging from 0.7 ‰ to 1.77 ‰ compared to Cala Ratjada specimens, and between 1.55 ‰ and 1.82 ‰ compared to those from Ciutadella. For $\delta^{15}N$, the amount of enrichment was very similar, with Columbretes specimens showing a mean enrichment between 1 to 1.6 ‰ compared to Cala Ratjada specimens and from 1 ‰ to 1.75 ‰ compared to Ciutadella specimens. In relation to the protection status, *S. scrofa* and *Z. faber* showed a slight enrichment in both carbon and nitrogen and a higher trophic level between samples from Columbretes Islands and Cala Ratjada ($p<0.05$), suggesting that both species from Columbretes occupy a higher trophic position compared to specimens from Cala Ratjada. These significant differences also appeared when we compared samples inside the protected area and outside the protected area within Columbretes Island MPA. Regarding trophic level, the majority of fishes appeared to occupy a trophic level between 3.01 and 4.22 with a mean value of 4.08 for fish from Columbretes Islands, 3.51 for those from Cala Ratjada and 4.2 for those from Ciutadella. The results highlighted the potential of carbon and nitrogen stable isotopes to gain extra insights into the functioning of marine ecosystems, and in particular in elucidating trophic relationships.